Vitamin E and Rapeseed Oil in Feed of Pigs - I. Influence on Animal Performance and Fresh Pork

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Vitamin E is present in a number of oils and fats of plants. In rapeseed oil it is found in various forms of tocopherols with a total of 600 - 800 mg/kg. In lean pork under various feeding conditions 1 - 5 mg vitamin E/kg meat are observed.

Rapeseed oil contains about 60% monounsaturated (MUFA) and about 30 % polyunsaturated (PUFA) fatty acids. Pork has 54 % MUFA and 9 % PUFA. With rapeseed oil in the diet the composition of fatty tissue in pigs could be changed to a higher degree of unsaturation. This increase demands, however, an enhanced protection of the double bonds in the fatty acids preferably achieved by vitamin E. The question arises if the natural content of vitamin E in rapeseed oil is sufficient to protect the fatty acids in pig tissues and how animals perform on feeding rapeseed oil and vitamin E in their diet and if quality characteristics of pork are changed.

Material and Methods

2 x 50 pigs (Pietrain x German Landrace) with a live weight of about 25 kg were divided in groups of 5 pigs each and fed with a normal barley and wheat diet or obtained in exchange nearly isoenergetically 2 resp. 6 % rapeseed oil with the supplementation of 0, 100 and 200 mg tocopherolacetate/kg feed. Additions of 35 mg resp. 175 mg $CuSO_4$/kg feed were also given with the feed. The animals received feed ad libitum until the day of slaughter. 24 h after slaughter the cold carcasses were cut and stored either chilled at 4°C for 2 to 3 weeks or kept frozen up to 6 months. A part of the frozen material was used for meat products manufacturing as reported in the following paper Nr. II. 'Influence on the Quality of Meat Products' by Rosenbauer et al..

The vitamin E concentration was measured according to Pfalzgraf et al. (1995) and the TBARS value after Botsoglou et al. (1994). Drip loss and colour (L*a*b*) with Minolta CM 508i was determined according to Honikel (1998). The sensory evaluation was done in pork chops after 3 and 6 months of frozen storage after grilling to an internal temperature of 75°C with a panel of 6 experienced persons. Statistical evaluation was done with SPSS.

Results and Discussion

The feeding trials started with piglets at an average live weight of about 25 kg and ended at the day of slaughter with an average live weight of about 105 kg. The dressing weights of carcasses varied from 80 to 90 kg. The daily uptake of feed was about 2.1 kg and the animals gained about 800 g weight per day (tab. 1). Consequently the feed efficiency was 2.67 kg feed/kg weight gain. There were no significant differences between the groups.

Feeding of 6 % rapeseed oil enhanced, however, the sum of unsaturated fatty acids in back fat from 53 to 67 %. The increase was mainly observed in C18:2 (linoleic acid) from 8 to 15 % and in C18:3 (linolenic acid) from 2 - 5 %. The addition of copper in the feed had no influence neither on aminal performance nor on quality characteristics of pork. Thus the results have been deleted here.

The vitamin E concentration in pork M. long. dorsi was 1.25 mg vitamin/kg meat in the control group and increased with 6 % rapeseed to 1.5 mg/kg and by supplementation of 100 mg tocopherolacetate/kg feed to 2.75 mg/kg and with 200 mg/kg feed to 3.8 mg/kg meat (fig. 1). During the storage in a chiller at 4 °C up to 14 days there was a slight decrease in the mean values of about 10 % which was, however, not significant. In back fat the concentrations of vitamin E were about 4 times higher than in M. long. dorsi. There was also no significant decrease during frozen storage.

Storage in the chilled state in the presence of oxigen enhanced the rate of oxidation in all cases. The largest increase was observed with 6 % rapeseed oil but without vitamin E supplementation in the feed. Within 2 weeks (1 - 3 weeks after slaughter) the TBARS values rose from 0.08 to 0.37 mg MDA/kg. The control samples (0.16 to 0.31 MDA/kg), the samples with rapeseed oil plus 100 mg vitamin E/kg (0.08 - 0.24) and plus 200 mg vitamin E/kg (0.06 - 0.24) showed with an increase of about 0.15 mg MDA/kg in two weeks only half of the enhancement and were lowest in the samples with vitamin E supplementation. During 18 weeks of frozen storage (vacuum packaged) no enhancement of TBARS-values (about 0.05 mg MDA/kg) was observed.
Drip loss depends on the integrity of cellular membranes. In the first days post mortem (2 - 5 days) there was a positive influence of vitamin E on the drip loss. But the decrease in drip loss was not significant and disappeared with storage periods beyond 5 days (fig.2).

Rapeseed oil addition reduced the colour brightness of M. long. dorsi from L*-value of 61 in control to 54 - 55 in samples with rapeseed, also in the ones which contained additionally higher concentrations of vitamin E. There was a decrease of the L* values in

control samples within the first two days of storage from 61 to 59. In all other samples there was no change of L* values between day 1 post mortem and 14 days of storage at 4°C.

Whereas vitamin E supplementation shows positive influences on quality characteristics, rapeseed oil counteracts partially the vitamin E actions. Only on colour brightness rapeseed oil reduces the L* to more pleasing darker values. But in the end the sensory appearance of the meat is decisive. A frozen storage for 3 months clearly showed that the rapeseed oil decreases the flavour of porkchops. The best samples were the control samples. After 6 months of storage the poorly evaluated samples were the ones with rapeseed oil alone or with rapeseed oil plus 100 mg vitamin E/kg in the feed (fig. 3). The best ones were those of the control and the ones with rapeseed oil plus 200 mg vitamin E/kg feed.

Conclusions

Vitamin E in feed protects pork meat and fatty tissue from oxidation. Vitamin E has a positive influence also on physical characteristics in the first few days post mortem like drip loss but none on the colour brightness of the rather light pork muscles. Vitamin E counterbalances the negative effects of rapeseed oil supplementation which per se shows no positive effects besides a reduction of a light meat colour to a darker appearance. The requests by some nutritionists to enhance the unsaturation of animal fats results in negative sensorical changes and it will be dangerous in its effect on enhancing oxidation products (radicals) which may cause cancer promotion and plaques.

References

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Honikel, K.O. (1998), Reference Methods for the Assessment of Physical Characteristics of Meat. Meat Science in press

Pfalzgraf, A., H. Steinhart and M. Frigg (1995), Rapid determination of α-tocopherol in muscle and adipose tissues of pork. Z. Lebensm. Unters.-Forsch. 200, p. 190 - 1993

fig.1 Vitamin E level in fresh and chilled pork loin slices (N=5)

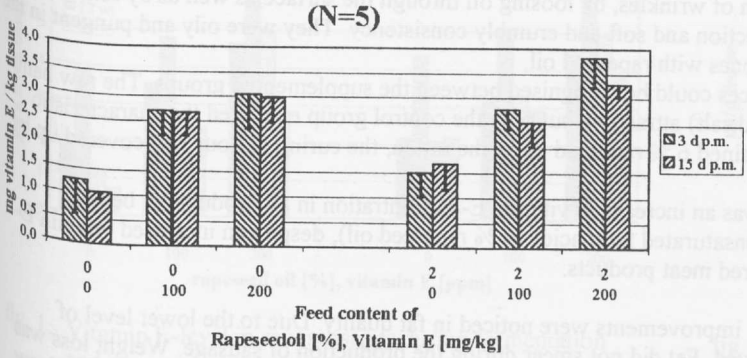


fig.2 drip loss of loin slices from 2 -5 days post mortem

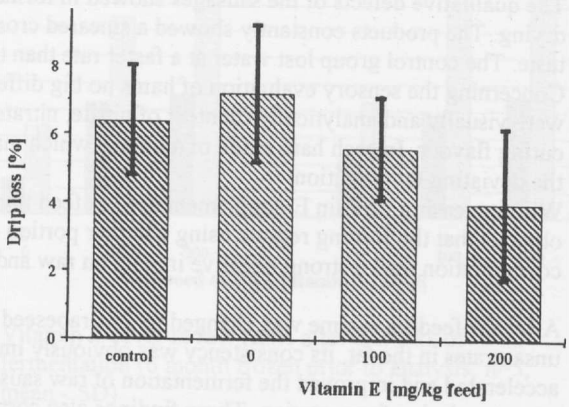
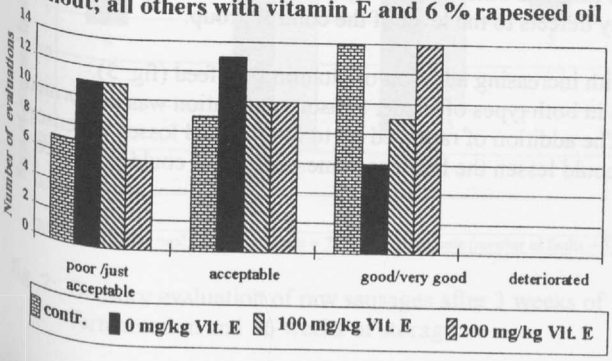


fig.3 Sensory evaluation of flavour of grilled pork chops after 6 months of frozen storage (-20 °C, n=5); control without; all others with vitamin E and 6 % rapeseed oil



Tab. 1: Influence of Vitamin E Supplementation in the Feed on Animal Performance

group	*control*	*+ 100 mg*	*+ 200 mg*
live weight, start kg	24.3 ± 1.9	24.5 ± 1.9	24.5 ± 2.8
live weight, slaughter kg	105.7 ± 2.4	106.1 ± 2.9	103.9 ± 3.4
feed consumption kg/day	2.14 ± 0.05	2.12 ± 0.08	2.11 ± 0.09
mean gain of live weight g/day	803 ± 40	799 ± 48	806 ± 45
kg feed / kg weight gain	2.67 ± 0.15	2.66 ± 0.22	2.62 ± 0.15

all data within rows are not significantly different